

28
CLAIMS

We claim:

- 1 1. A method for embedding a watermark into content, said content containing content
2 samples, comprising the steps of:
3 (a) receiving said content;
4 (b) creating a continuous watermark sequence from said watermark;
5 (c) for each content sample in a first predetermined order:
6 (i) calculating a sample mean;
7 (ii) calculating a sample variance; and
8 (iii) normalizing said content;
9 (d) generating a set of content coefficients from said content;
10 (e) generating a set of watermark coefficients from said watermark sequence;
11 (f) embedding said watermark in said content by adjusting the amplitude of said
12 watermark coefficients so that the distortion between the content coefficients
13 and the associated watermark coefficients are minimized using a secret
14 mapping function; and
15 (g) outputting said content.
- 1 2. The method according to claim 1 wherein said step of embedding said watermark in
2 said content is performed by adjusting the watermark coefficients sequentially in a
3 second predetermined order.
- 1 3. The method according to claim 1 wherein said digital content is an image and said
2 content sample is a pixel.

- 1 4. The method according to claim 1 wherein said secret mapping function has
2 parameters, and said parameters are controlled by one or more key-dependent
3 sequences.
- 1 5. The method according to claim 4 wherein said key-dependent sequences are key-
2 dependent random sequences.
- 1 6. The method according to claim 4 wherein at least one of said key-dependent
2 sequences are uniformly distributed.
- 1 7. The method according to claim 4 wherein at least one of said key-dependent
2 sequences is continuous.
- 1 8. The method according to claim 4 wherein at least one of said key-dependent
2 sequences is secret.
- 1 9. The method according to claim 1 wherein each watermark coefficient may have a
2 different quantization step size.
- 1 10. The method according to claim 1 wherein said secret mapping function is a
2 sawtoothed function.
- 1 11. The method according to claim 1 wherein said secret mapping function is a triangle
2 mapping function.

- 1 12. The method according to claim 1 wherein said secret mapping function is a binary
2 function using randomized quantization steps.
 - 1 13. The method according to claim 1 wherein said secret mapping function is generated by
2 a program.
 - 1 14. The method according to claim 1 wherein said secret mapping function is continuous.
 - 1 15. The method according to claim 1 wherein said secret mapping function is piecewise
2 continuous.
 - 1 16. The method according to claim 1 wherein said secret mapping function is a look-up
2 table.
 - 1 17. The method according to claim 1 wherein said secret mapping function is a pixel
2 based function.
 - 1 18. The method according to claim 1 wherein said first predetermined order is a raster
2 scan order.
 - 1 19. The method according to claim 2 wherein said second predetermined order is a zig-zag
2 order.
 - 1 20. A method for extracting a watermark sequence from watermarked content comprising
2 the steps of:

- 3 (a) receiving watermarked content comprising received coefficients;
- 4 (b) generating an estimated watermark determined by received coefficients, and a
- 5 mapping function;
- 6 (c) generating a watermark sequence using a correlation function, said correlation
- 7 function using the watermarked content, the estimated watermark, a scaling
- 8 factor, and a weighting factor per a predetermined equation; and
- 9 (d) outputting the watermark sequence.

- 1 21. An apparatus for extracting a watermark sequence from watermarked content
- 2 comprising:
- 3 (a) a noise source;
 - 4 (b) a key dependent sequencer;
 - 5 (c) a mapping function having parameters, at least one of said parameters
 - 6 receiving input from said key dependent sequencer;
 - 7 (d) a watermark estimator, said watermark estimator generating a watermark
 - 8 estimate from the watermarked content, and the mapping function.
 - 9 (e) a scale factor;
 - 10 (f) a weight factor; and
 - 11 (g) a correlator, said correlator generating the watermark sequence from the
 - 12 watermarked content, the scale factor, the weight factor and the watermark
 - 13 estimate.

- 1 22. An apparatus for embedding a watermark data into content including:
- 2 (a) a content preprocessor, said content preprocessor further including:
 - 3 (i) a mean calculator; and

- 4 (ii) a variance calculator;
- 5 (b) a content coefficient generator for generating content coefficients from the
- 6 preprocessed content;
- 7 (c) a watermark sequence generator for generating a watermark sequence from the
- 8 watermark data;
- 9 (d) a watermark coefficient generator for generating watermark coefficients from
- 10 the watermark sequence; and
- 11 (e) a watermark inserter for generating watermarked content.

1 23. An apparatus according to claim 22, wherein said watermark inserter further includes:

- 2 (a) a key dependent sequencer;
- 3 (b) a secret mapping function device, said secret mapping function device
- 4 receiving input from said key dependent sequencer; and
- 5 (c) a coefficient modifier for generating watermarked content by adjusting the
- 6 amplitude of the watermark coefficients so that the distortion between the
- 7 content coefficients and the associated watermark coefficients are minimized
- 8 using the secret mapping function device.